A NATIONAL STUDY ON THE LAST DECADE OF RESEARCH ON ISOMETRIC AND ISOTONIC RELATIONSHIP

by

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INDEX

Introduction. 1

Purpose. 2

Definition of Terms. 3

Research and Procedures 6

Related Literature. 8

Analysis and Discussion 30

Author's Related Research 43

Summary and Conclusion 57

Bibliography. 59

Appendix. i

TABLES

Page

Table I Beliefs of sixty-five Authors over the Nation Concerning Isometric, Isotonic, or a Combination of the Two.....30

Table II Body Capacity Developed as Proposed by the Isometric Supporters.....36

Table III Body Capacity Developed as Proposed by the Isotonic Supporters.....37

Table IV Body Capacity Developed as Proposed by the No Significant Difference Supporters.....38

Table V Body Capacity Developed as Proposed by the Split Belief Supporters.....39

Table VI Body Capacity Developed as Proposed by the Combination Supporters.....40

Table VII Beliefs as to an Area Concerning Isometric, Isotonic, or a Combination of the Two.....41

Table VIII Individual Improvement of the Girth of Isometric and Isotonic Group.....45

Table IX Individual Improvement of the Girth of the Isotonic Group.....47

Table X Mean Difference of the Girth of the Combined Group and Isotonic Group.....49

Table XI Individual Improvement of Strength of the Isometric/Isotonic Group.....51

Table XII Individual Improvement of Strength of the Isotonic Group.....53

Table XIII Mean Difference of the Combined and Isotonic Group Strength.....55

INTRODUCTION

During the last ten years, there have been many new ideas developing for the improvement of physical training and body development. These attitudes on body development have been the result of a combination of many things. One reason, obviously, is that (1) individuals are striving to become more proficient in various athletic skills. This idea of improvement in physical fitness has probably resulted from the high level of competition as examplified in modern day athletics. Another major reason for the great strides in the improvement of physical development is (2) the emphasis coming from the federal government in training personell in all areas of military service. Because of the publicity from the different national levels, individuals are thinking and striving to become physically fit.

The general public as well is interested in ways of becoming physically fit and the reasons for performing certain types of exercises. This includes easy methods of losing weight, strengthening muscles and thus becoming physically fit. With these wants and needs in the foreground, there have been numerous articles written and considerable research done to discover the answer to these questions concerning physical training. Numerous suggestions have been made by various authorities for becoming physically fit. So, from the research and investigations, many varying ideas have developed concerning the most

beneficial way of training in order to become physically fit.

One soon wonders which system is the best type of training program. This is especially true when considerable emphasis has been placed in recent years, on the isometric and isotonic types of training programs, as well as combinations of the two above mentioned programs. Considerable controversy has arisen as to which is the best type of training program. After all, with one group of investigators advocating in detail one type, and another group advocating another, what can the public be expected to believe.

Purpose

The first purpose of this study is to summarize certain of the nations authors writings that have appeared in the last ten years concerning the most beneficial type of training programs.

The second purpose is to point out the trends during the last ten years as stated by selected authors in the field. These will be in the form of a short review of research and beliefs as expressed in various writings concerning the best method as related to isometric and isotonic exercise and a combination of the two exercises.

The third purpose is to point out different author's beliefs as to what body capacity is developed, namely strength, girth, flexibility, endurance and general body development, through

the isotonic, isometric or combined training programs.

The fourth purpose was to point out the training program of twenty-four selected authors beliefs from the different areas of the country, to discover if there is a common belief on the best method of physical development.

Definition of Terms

In Karpovich's and Rasch's books, the terms used in this report are defined as follows:[1,2]

Static Contractions. When a muscle develops tension which is in-sufficient to move a body part against a given resistance, it is said to be in static contraction.

Isometric Contractions. Physiologists often refer to static contraction as isometric contraction.

Isotonic Contraction. When a muscle is able to move a load, work is accomplished and the muscle is said to have performed a rootonic contraction.

Concentric Contraction. When a muscle develops tension sufficient to overcome a resistance, so that the muscle actually shortens and moves a body part in spite of a given resistance, it is concentric.

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[1]Karpovich, F. V. Physiology of Muscular Activity, Philadelphia, W. B. Saunders, Co., 1959. pp. 65.

[2]Rasch, P. J. and R. K. Burke, Kinesiology and Applied Analogy, (Philadelphia: Lea and Febrger), 1959. pp. 24.

Phasic Contractions. When a muscle is allowed to shorten, contraction is sometimes considered synonymous with isotonic.

Eccentric Contraction. When a given resistance overcomes the muscle tension so that the muscle actually lengthens, it is eccentric.

Flexion. This decreases the size of the angle between the anterior surfaces of articulated bones except for the knee and the toe joint.

Extension. The opposite of flexion, as this increases the size of the angle between the anterior surfaces of articulated bones.

Set. Refers to one prescribed exercise bout.

Repetition. Refers to the execution of one prescribed exercise movement.

Strength. It is the capacity of a muscle to exert force against a resistance and is measurable only by a single maximal effort.

Power.[3] This is the product of speed and force of a muscle. Muscular power would be the ability of a muscle group to release maximal power in a short period of time. If the speed factor was taken away, then power and strength would be synonymous.

Muscular Endurance. This or holding time is the ability to maintain a given sub-maximal weight at a given angle over-

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[3]Darling, Francis E. "The Effects of Isometric and combined Isotonic and Isometric Exercise on High School Students." Master's Report 1963. Kansas State University.

time.

Muscular Contraction. This term refers to the development of tension within a muscle.

RESEARCH AND PROCEEDURES

In the process of this study, the author wrote to several universities in different areas of the country requesting information concerning isometric and isotonic comparisons. Microcards of theses for both master and doctorate degrees were received, examined and evaluated. A visit was made to the Washington University Library and the St. Louis University Library to gather information on isometrics and isotonics. The major portion of the research was conducted at the Kansas State University Farrell Library. The author has made a study of the subject using the Kansas State University Physical Education service classes.

The opinions of sixty-five authors were collected and reviewed. These varying ideas and beliefs written in the last ten years have been combined to produce a true picture of the current beliefs. The authors of these articles and their opinions have been compiled in annual tables through the last ten years. These tables demonstrate current opinions as to the most beneficial exercise. They will also present a clear picture of how ideas have changed through the years.

Authors have done research in different phrases of physical development. Various authors believe that different exercises improve different types of physical development. As a result, several tables have been designed to show the most prominant type of physical development of each type of exercise group (isometric, isotonic, a combination of the two,or the no sign-

ificant difference group).

RELATED LITERATURE

In developing this study, the investigator has gone to great lengths to discover as many differing beliefs as possible. The following beliefs will not be under a certain topic heading, but as to the date at which these beliefs were written. The beliefs were taken from research which has been done by various professional individuals in the field in the fulfillment of the requirements for the Master and Doctor iate degrees, for individual gain and others have been opinions taken from Periodicals and various text books.

Each author's belief listed here, has become a small part of this study.

1955

In 1955, Steinhaus reviewed the findings of Hettinger and Muller on strength development through static contractions and stated:[4]

1. Muscle strength increases an average of five per cent per week when the training load is as little as one-third in even less of maximal strength.

2. One practiced period per day in which the tension was held for six seconds resulted in as much increase in strength as longer periods.

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[4]Steinhaus, A. H. "Strength from Manpower to Muller-A Half Century of Research." Journal of the Association for Physical and Mental Rehabilitation. Sept. 1955. pp. 147-153.

3. Muscle strength increases more rapidly with increasing intensity of training load up to two-thirds of maximal strength. Beyond this increase in training load, it has no further effect.

Steinhaus perhaps summarized the feelings many have about isometric contraction by stating, "There is no special magic in isometric contraction beyond its convenience."[5]

Lorback's study attempted to determine the relative effectiveness for production of strength and muscle girth, through the use of two types of training. One method used short periods of static contraction and the other used the customary weight training method. Sixty males were used for a section of required physical education program at Pennsylvania State University. The muscle groups tested those involved in right and left hand grip strength, neck, right and left elbow flexion and extension. Group B trained using contractile pulls against two-thirds of those tested with maximum pull for six seconds, per muscle group, per training period. Group A trained with weights, using ten repetitions of each exercise each training period. Results are as follows:[6]

1. Both groups gained significantly in strength.
2. Both groups gained significantly in muscle girth.
3. Group B gained a greater amount of strength than group

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[5] Ibid.

[6] Lorback, Melvin M. "A Study Comparing the Effectiveness of Short Periods of Static Contraction to Standard Weight Training Procedures in the Development of Strength and Muscle Girth." Thesis M. S., Pennsylvania State University, 1955.

A in the muscle groups involved in knee flexion.

Baer and co-workers at the same time studied the effect of repetition rate with both forms of contraction. Their result showed that the isometric group improved more in strength than the isotonic groups after a six-week experimental period.[7]

Salter compared the effect of four training types of Isometric and Isotonic muscle contraction training programs on the supination of the left hand. She found all training programs resulted in an improvement in muscle strength, but no significant differences were found between the four training methods used.[8]

1956

Wolbers and Sills, working with two groups of High School students, checked the subjects on four tests of strength before and after an eight week training session of isometric contractions. One group of ten boys served as the control group, while the other ten boys paired off and performed resistance exercises (all out effort for six seconds against their partner's hands). In the four strength tests administered (back

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[7]Baer, A. D., J. W. Gersten, B. M. Robertson and Dinken. "The Effect of Various Exercise Programs on Isometric Tension, Endurance and Reaction Time." Archives of Physical Medicine and Rehabilitation, 36:495-502, 1955

[8]Salter, Nancy. "The Effects of Muscle Strength of Maximums Isometric and Isotonic Contraction at Different Repetition Rates." Journal of Physiology, 130:104-113, October 1955.

lift, leg lift, combined hand grips and the Sargents Jump), the experimental group showed significant gains over the control except in the Sargent Jump. The investigators concluded that strength increases but it does not necessarily bring about performance increase.[9]

Rodgers purpose, in his study, was to compare the amount of strength developed by two methods of weight training, one based on concentric contractions, and the other on static contraction. Twenty male students enrolled in weight training courses at the State University of Iowa were the subjects. Strength tests were the setup, pushup, pullovers and curls. In the six week period, both groups gained in strength as measured by the four tests. With the exception of one administration of one test, the static group exceeded the concentric group in all of the tests. The difference between the gains were not statistically significant. Hence, the hypothesis that the two methods do not differ relative to effectiveness in the development of strength, is accepted.[10]

1957

Rasch conducted a study which showed that measurements of

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[9]Wolbes, C. P. and F. D. Silzs. "Development of Strength in High School Boys by Static Muscle Contraction," Research Quarterly, 27:446-451, 1956.

[10]Rodgers, Donald P. "The Development of Strength by Means of Static and Concentric Muscle Contractions." Thesis M. S., State University of Iowa, 1956.

maximum strength made by the use of isometric techniques are valid in expressing isotonic strength of trained subjects.

"It was found that the subject could exert a mean isometric tension of 43.2 pounds, with a standard deviation of 3.4 pounds, and a mean maximum isotonic contraction of 41.8, with a standard deviation of 6.9. The difference of 1.4 pounds between the two means was of no statistical significance."[11] So far as trained male subjects are concerned, there appears to be no great difference between the amount of tension.

Morgan performed a similar experiment as did Lorback. He concluded that neither static non-phasic exercise is superior to the other in the development of muscular strength and size.[12]

Mathews and Kruse examined the effectiveness of varied frequencies of Isometric and Isotonic exercises on strength and the change in strength of the elbow flexions. One hundred twenty college students were used, sixty exercising isotonically on an ergo-meter (load three-sixteenths of strength at .30 repetitions per minute until exhaustion), and sixty exercising isometrically exerting three consecutive six second pulls at maximum tension. The two exercises units were sub-divided in

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[11] Rasch, P. J. "Relationship Between Maximum Isometric Tension and Maximum Isotonic Elbow Flexion," Research Quarterly, 28:85, March 1957.

[12] Morgan, W. P. "The Effectiveness of Static Exercise verses Opposed to Phasic Exercise for Increasing Muscular Strength and Size." (Unpublished Master's Thesis), University of Maryland, 1957.

four groups of fifteen with each respective group exercising 2, 3, 4 and 5 times a week. They found no significant difference between the means of the two groups, although it was observed that the isometric type exercise caused a greater number of subjects to gain significantly in strength.[13]

Swegan's study attempted to determine the effect of static contraction and standard weight training procedures on certain movement speeds and endurance. Subjects in the study were male freshmen enrolled in the required physical education program at the Pennsylvania State University. Group A used bar bells for training and worked toward ten repetitions. The exercise consisted of one arm shoulder curls, one arm shoulder press and squats. Results were as follows:

1. Speed of movement, based on composite scores, was slowed down significantly after the weight training by each method and there was no significant difference between the two groups.

2. Muscular endurance, based on composite scores, both groups increase significantly.

3. Static contraction appeared to be more effective for developing endurance in knee extension.[14]

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[13]Mathews, D. K. and R. Kruse, "Effects of Isometric and Isotonic Exercises on Elbow Flexion Muscle Groups." Research Quarterly, March 1957.

[14]Swegan, Donald Bruce. "The Comparison of Static Contraction with Standard Weight Training in Effect on Certain Movement Speeds and Endurances." Thesis Doc. of Ed., Pennsylvania State University, 1957.

In Rasch and Morehouse's observation that "Isotonic exercises probably produce better results from the psychological as well as the physiological aspects;"[15] Subjects in both groups expressed dislike for isometric efforts. They complained that it was frustrating to exert their full strength and see almost nothing happen; and that this type of exercise was boreing.

1958

Mayberry concluded, after doing an experiment on thirty-six subjects at Michigan State University on the effects of isometric exercises, that "a maximal or submaximal isometric contraction of a muscle of very short duration done once a day, five days a week for five weeks will not significantly increase the strength of that muscle.[16]

Liberson and Asa specifically compared the DeLorme system of Progressive Resistance Exercise with the Hellinger-Muller isometric system. They concluded that "... daily, single brief isometric exercises increase muscle strength more rapidly and at least as fully as classical isotonic exercises. They gave

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[15]Rasch, P. J. and L. E. Morehouse. "Effect of Static and Dynamic Exercises on Muscular Strength and Hypertrophy," Journal of Applied Physiology, 11:29-34, 1957.

[16]Mayberry, Robert A. "Isometric Exercise and the Cross-Transfer of Training Effects as it Relates to Strength," College Physical Education Association Proceedings, December 1958.

this reason:

> During voluntary isotonic contractions, the muscles are below normal resting length most of the time. It is reasonable to assume that during such contractions the full benefits of the exercise are gained by the muscles only during brief periods of time when it approaches its normal resting length intermittently. During the isometric exercises which we studied, the muscle was continuously contracted under the optimum conditions for the entire six second period and this may be more beneficial.[17]

Wickstrom attempted to determine whether the single submaximal contraction could produce significant strength increases. He reported his observations that extremely weak individuals responded significantly to the single effort whereas the well conditioned person responded less favorably.[18]

Karpovich has stated that "A person doing isometric work could get a complete body workout in five minutes, with weights the workout period may last one or two hours."[19]

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[17] Liberson, W. T. and M. M. Asa. "Brief Isometric Exercise," Therapeutic Exercise, ed. by S. H. Licht, Physical Medicine Library, vol. 3, New Haven, Conn. 1958.

[18] Wickstrom, R. L. "An Observation on the Isometric Contraction as a Training Technique," Journal of the Association for Physical and Mental Rehabilitation, 12:162-165, 1958.

[19] Karpovich, Peter J. Physiology of Muscular Activity, Philadelphia: W. B. Sanders, 1958, page 13.

1959

Meadows made a study to determine the effects of isotonic and isometric contraction training on speed and force of the offensive football charge and static and dynamic strength. The subjects were members of the freshmen and varsity football squads at St. Cloud State College and all subjects had experience with the fundamentals of the offensive football charge movement. Subjects were assigned randomly to one of three groups, an isotonic group engaged in a weight training program, an isometric group participated in a static training program, and a control group engaged in regular physical education. Following are the conclusions:

1. No significant differences at the one per cent level in speed of offensive football charge.

2. In comparison between groups on force of offensive football charge, revealed no significant difference between Isometric and Isotonic.

3. Isotonic had a greater effect on improvement in the performance of the chins than the other two programs.

4. There were no significant differences in the dip test, vertical jump and right and left grip strength test.[20]

Newlin, in a study similar to Wolbers and Sills, concluded

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[20]Meadows, Paul Eugene, "The Effect of Isotonic and Isometric Muscle Contraction Training on Speed, Force and Strength," Thesis Ph. D., University of Illinois. 1959.

that "... while strength may be gained by isometric training, there may be little improvement in the performance of such isotonic skills as the standing broad jump and the Sargent Jump."[21]

Asa found there was no difference between isotonic groups and the single isometric group in the development of endurance.[22]

1960

Peterson investigated the effects of muscle training by static, eccentric and concentric contraction. The results, when compared to the control group, showed that the one daily maximum isometric contraction had no effect on the isometric muscle group strength. The ten daily maximum isometric contractions had a tendency to increase the isometric strength, while ten daily maximum eccentric contractions had no effect on the strength of the muscle. Heavy dynamic work increases isometric strength by twelve per cent in the females and twenty-three per cent in the males. Endurance did not change in any of the programs.[23]

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[21]Newlin, B. "Relation of Isometric Strength Training to Isotonic Strength Performance." Unpublished Master's Thesis, University of California, 1959.

[22]Asa, M. Maxim. "The Effects of Isometric and Isotonic Exercises in the Strength of Skeletal Muscle." Microcard of Ph. D. Thesis, Springfield College, 1959, page 2.

[23]Peterson, F. B. "Muscle Training by Static, Concentric and Eccentric Contraction." Acta Physiologica Scandinavica, vol. 48, 1960, pp. 406-416.

There was no significant correlation between static strength and "strength in action" computed from the arm mass and the speed of the movement. The results agree with the concept that strength as ordinarily measured is determined by a neuromotor coordination pattern rather than the ultimate physiological capacity of the muscle. The neuromotor pattern energizing the muscle is different during movement.[24]

The speed of a lateral arm movement and the strength/mass ratio were measured in forty-eight university male students. The correlation between the movement time and S/M was not significant and verified the results of similar studies from this laboratory. The reliability of individual differences for all variables was high. These findings support the concept that ability to exert muscular strength in a coordinated manner is determined by a specific neuromuscular coordination pattern.[25] Walters and colleagues investigated the effects of short bouts of isotonic training, isometric training with maximal and two-thirds maximal resistance. They found that all methods were effective in increasing strength significantly. They also found an improvement in the contralateral unexercises limb as

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[24]Henry, F. M. and J. D. Whitley. "Relationship between Individual Differences in Strength, Speed and Mass in an Arm Movement." Research Quarterly, 31:24, March 1960.

[25]Clarke, D. H. "Correlation between the Strength/Mass ratio and the Speed of an Arm Movement." Research Quarterly, 31:570, December, 1960.

a result of both isometric and isotonic contraction.[26]

1961

Perkins and Kaiser found the DeLorme 10 RM more effective than a daily isometric exercise in increasing strength of the ankle plantar flexors, the knee extensions and the hip extensions in persons over sixty.[27]

Scott and Ungar, in using an "isometric dynamometer" with an adult physiotherapy patient, found that the isotonic group was stronger at the end of the first week. At the end of the second week, the isometric group was superior by twenty-five per cent, the third week by thirty per cent and the fourth week by twelve and four hundredths per cent.[28]

1962

Boiteau's purpose of this study was to evaluate the relative effects of concentric, eccentric and isometric exercise programs conducted daily over a seven week period upon the strength and girth of the dominant arm elbow flexor muscles.

The results indicated that the training program used by all

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[26]Walters, L. E. and C. L. Stewart and J. F. LeClair, "Effect of Short Bouts of Isometric and Isotonic Contractions on Muscular Strength and Endurance." American Journal of Physical Medicine, 39:137-141, 1960.

[27]Perkins, Lois C. and Helen L. Kaiser. "Results of Short Term Isotonic and Isometric Exercise Program in Persons Over Sixty." Physical Therapy Review, 41:9, Sept. 1961, pp. 633-655.

[28]Scott, B. O. and Ungar, G. H. "An Isometric Dynamometer and Treatment Unit," Physics and Therapy, vol. 47, Sept. 1961, pp. 270-273.

experimental groups increased in at the .05 level of significance or better while the control group did not demonstrate a statistically significant increase. The experimental groups when compared with each other, no one group was markedly superior as opposed to the other two groups.

Boiteau's review of literature reveals that neither isometric exercise programs nor isotonic exercise programs were superior to one another in the development of strength and girth.[29]

Lawrence, Meyer and Matthews investigated the effectiveness of isometric exercises as compared with isotonic exercises in the development of muscle strength in the quardriceps femoris of twenty-three subjects. One group performed progressive weighted isometric exercises and the other group exercises by DeLorme (isotonic) method for the right quadriceps femoris. Their training period covered nineteen exercise days. It was found that development of strength in the quadriceps muscle by isometric exercise was less than that by isotonics, according to the per centage of increase in the weight of the exercise loss when both were performed against progressive maximal resistance. The endurance component of the quadriceps muscle underwent greater increase with the isometric than with the isotonic exercise employed, according to comparative performance of the

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[29]Boiteau, Richard Arden. "The Effects of Training, Utilizing, Static, Concentric and Eccentric Contraction on the Strength and Girth of Skeletal Muscles." Thesis M. A. University of Maryland, 1962.

two groups in tests with maximally resisted contractions of brief and long duration.[30]

Hellebrandt believed that "Overload stress, judiciously pushed to progressively increasing limits of tolerance, is the key to strength training, learning and not the small effective effect performed as infrequently as possible."[31]

The purpose of Marley's experiment was to compare the effectiveness of isometric exercises and isotonic exercises in the development of muscular strength, endurance and size. Thirty-one male college students from two weight training classes and in Physical Education orientation classes were used at Maryland University, 1960-1961.

A. Isometric Group

B. Isotonic Exercises

C. Controlled Group (softball, basketball, swimming)

The results are as follows:

1. There is little difference in the effectiveness of isometric and isotonic exercises in the development of strength.

2. Isometric exercise is more effective in the development of isometric endurance.

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[30]Lawrence, M. S. and H. R. Meyer. "Comparative Exercise in Muscle Strength in the Quadriceps Femoris by Isometric and Isotonic Exercise." Physical Therapy Journal Association, January 1962.

[31]Hellebrandt, F. A. "The Scientific Basis of Weight Training." Weight Training in Sports and Physical Education, AAHPER, 1962, Washington D. C.

3. Isotonic exercise is more effective in the development of isotonic endurance.

4. Isometric endurance and isotonic endurance appears to be separate physiological phenomena.

5. Isotonic exercise is more effective in the development of muscular size.

6. The strength of the muscle is not necessarily proportioned to its size as measured by this study.[32]

Berger found that dynamic training improved dynamic strength more than static strength did, and static training improved static strength more than dynamic training. Improvements in static strength did not produce corresponding increases in dynamic strength and vice versa.[33]

Thompson reports that in weight training vs isometric training, "Both gained significantly in strength, indicating that both training programs were effective for developing strength of the muscle groups in muscle girth or size of body."[34]

1963

The purpose of Richardson's study was to compare the effects

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[32]Marley, William Paul. "The Comparative Effectiveness of Isotonic Exercise in the Development of Muscular Strength, Endurance and Girth." Thesis M. S. Univ. of Maryland, 1962.

[33]Berger, Richard A. "Comparison of Static and Dynamic Strength Increase." Research Quarterly, 33:3, 1962, pp. 334,338.

[34]Thompson, Hugh. "Weight Training vs Isometric Training." Scholastic Coach, October 1962, pp. 44, 45.

of short term isometric and isotonic exercise programs or the development of strength and muscular endurance. More specifically the interest was to investigate the relative effect of these two exercise programs in the development of the strength and muscular endurance of the extension of the knee.

Sixty grade ten boys were randomly divided into three groups; an isotonic training group, an isometric training group and a control group.

The isometric exercise program consisted of three, six second maximal contractions a day, one ninety degrees, one 135 degrees and one 165 degrees.

The isotonic group carried a maximal weight from the ninety degree flexion position to the 165 degree extension position in a time period that required six seconds. This movement was repeated three times daily. The weight was increased by one and one-fourth pounds of individual performed exercise the day before which served to establish a new maximal weight.

The initial and final tests for strength were measured by a specially constructed strain gauge exercise table at angles of 115 degrees and 135 degrees. Time endurance was measured, also. The results are as follows:

1. The isotonic exercise group increased significantly over the isometric group at the 135 degree angle and both increased significantly over the controlled group.

2. There was no statistically significant difference between isometrics and isotonics at 115 degrees.

3. Both isometrics and isotonics had more endurance over the control group.[35]

Darling's study has been made to observe the effects of isometric contractile work on the strength of students of high school age, and to show the effects of isometric and isotonic contractions in certain areas of physical fitness.

The data was collected by dividing the physical education classes of Riley County High School into various control groups. The boys were tested at the start of the program and after eight weeks of work. One group was of isometrics, one group was of combined isometrics and isotonics and one group was of pure isotonics. The results showed that a positive gain can be made by resistive exercise whether it be isometrics, combined isotonics and isometrics, or isotonics. In almost every area of work, the combined exercise group made slightly higher scores. The isometric group was second and the isotonic group third. This would indicate that for a group, more of an increase could be made by combining the isometric and isotonic exercise. There was no evidence that any one type or group of individuals made a greater increase. In the two different groups, the biggest increases were made by top athletes. The amount of increase

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[35]Richardson, John R. "The Effect of Brief Isometric and Isotonic Exercise Programs on the Development of Strength and Muscular Endurance." Thesis M. S. University of Alberta. 1963.

can not be predetermined. There is a tendency for large ranges of difference between different individuals.[36]

Burnham's investigation attempted to determine the relative effectiveness of the two types of training in the production of strength and muscle girth. One method used isometric contractions and the other used isotonic contractions. The findings showed that each group gained significantly in strength. Both groups gained in muscle girth.[37]

1964

The primary purpose of Macintosh's study was to investigate the relationship between strength and speed of forearm flexion and neuromotor skill. Part of the conclusion was as follows:

The isotonic strength training program carried out three times a week for eight weeks by the subjects in the isotonic group was found to be significantly more effective by cable tensiometer tests than was an isometric strength training program in speed strength movement. The isotonic group also exhibited a significantly higher adjusted post-experiment strength/mass mean than that of the isometric group. How-

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[36]Darling, Francis E. "The Effects of Isometric and Combined Isometric and Isotonic Exercise on High School Students." Master's Report, Kansas State University, 1963.

[37]Burnham, Stan. "The Value of Combined Isometric and Isotonic Exercise." Physical Power, 1963. pp. 14, 15.

ever, the isometric strength training program carried out three times a week for eight weeks by subjects in isometric groups also resulted in a significant mean gain in strength/mass and in strength of forearm flexion. The results of this study indicated that isotonic strength training programs result in significantly greater gains in strength than do isometric programs; the results indicated that increasing the strength of the muscles which move a limb will not result in corresponding increases in speed with which the limb can be moved. Practice in maximal speed of movement groups did not affect significant improvement in the speed of the limb.[38]

Probably the latest theory concerning a program for workout to develop strength, girth and endurance has been brought out by Exer-Genie Incorporated.

"The Exer-Genie is very much needed as a 'breakthrough' in that it combined the latest theories in resistive exercise. By starting each exercise isometrically, we get strength benefits of this new school of exercise and by combining it with isotonic movement we get the benefits of endurance and flexibility. We have valuable time because by starting the exercise isometrically we are working a tired muscle when we start out movement and this enables us to cut out the needless repet-

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[38]Macintosh, Donald deFrayne. "The Relationship of Individual Differences and Subsequent Changes in Static Strength with Speed of Forearm Flexion Movement..." Thesis Ph. D. 1964, University of Oregon.

ition of movements."[39]

1965

Dr. John E. Magelsdorf, Human Performance project leader, Bioastronautic Laboratory, predicts that with a device such as the Exer-Genie, an astronaut could probably keep in good physical condition by exercising as little as four times a day for periods of six minutes each. Use of the Exer-Genie combines both isometric exercise and isotonic exercise.[40]

Dr. James Brusky, one of the Packers team physicians, stated "When a muscle is fatigued it builds up lactic acid, especially after repetition of an exercise over a long period of time. Exercises that take a short time do not cause such a build-up of the fluid which causes stiffness and cramps."[41]

Vince Lomabardi, head football coach of the Packers, believes that an Exer-Genie type of work-out, a combined isometric and isotonic exercise, with a few calisthenics and agility drills, will help build a better football team.[42] Higdon, in his article, is trying to clarify the ideas that have developed since 1952. He states that "if your aim is physical fitness, keep those books, pamphlets, and magazine articles promoting isometrics,

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[39] _____, "It's Fun to Get Fit with Exer-Genie Exercises." Exer-Genie, Fullerton, California, 1964.

[40] _____, Lockheed, M S C Star, November 24, 1965, p. 5.

[41] Johnson, Chuck. "A New Push-Pull for the Packers." The Milwaukee Journal. August 8, 1965, part 4.

[42] Ibid.

but don't be afraid to flop down on the floor for some pushups. You may sweat a bit, but remember you can always take a shower."

"The rules are simple: Unless you contract your muscle at least two-thirds or more of that muscle's strength, you are not going to regain the so-called benefits of a five per cent gain in strength per week. Such a contraction is easier alone in print than in practice. Moreover, the original claims by Hettinger and Muller of a five per cent strength seems, in the light of additional research, to be exaggerated."

He also points out that Physiologists criticize the idea that general body strength can be built by a few isometric exercises. "This is a falsehood" claims Jay Bender, a professor in the department of physiology at South Illinois University, "Isometrics are very specific. You exercise one muscle at a time."

According to Higdon's article, "Let's Tell the Truth About Isometrics," it was stated that if a person had only one weakness, it is quickly and easily remedied because there is probably only one muscle area that has to be isometrically dealt with. However, if you're interested in general conditioning, isometrics are as time consuming as any other set of exercises used for this purpose.

He also stated that "Isometrics will produce tight muscles, but fifty push-ups may be better for physical fitness. Higdon further mentioned that many promoters of particular exercise

systems often fail to point out that more goes into fitness than strong muscles. Athletes may do isometrics or lift weights, but they also perform incidental and planned running, which develops pulmonary-cardiovascular reserve for healthful and successful performance.

Some resulting advantages are good therapeutics, having special advantages in shaping parts of the body, or developing flabby stomach muscles. Also, isometrics are excellent for use in the space program because of the limitations for exercising in the space craft.

Isometric strength is gained quickly and also lost quickly according to the University of Iowa's Doctor Paul. He further indicates that psychologically, it is hard for individuals to concentrate on more than two or three isometric exercises.

Jay A. Bender, physician, set up Isometric Programs for the Pittsburgh Pirates and San Francisco Forty-Niners football squads which is a definite indication that he is a supporter of Isometrics.

ANALYSIS AND DISCUSSION

A group of sixty-five authors, who in the last ten years have been considered authorities in the field of physical education, were selected for this study as to their written beliefs concerning which type of exercise is beneficial among isometric exercise, isotonic exercise or a combination of the two. Others are professional individuals who have tried to find the real answer to the above question. An effort has been made to select the authors who had professional knowledge of the physiology of exercises or material professors.

TABLE I

BELIEFS OF 65 AUTHORS OVER THE NATION CONCERNING ISOMETRIC, ISOTONIC, OR A COMBINATION OF THE TWO

Year	Author	Isometric	Isotonic	Comb.	No Sign. Diff.
1955	Arthur Steinhaus				X
"	Nancy Salter				X
"	B. M. Robertson	X			
"	Dinken	X			
"	Melvin M. Lorbach				X
"	A. D. Baer	X			
"	Doncus and Salter				X
"	J. W. Gersten	X			
1956	Donald P. Rodgers				X
"	C. P. Wolmers	X			
"	F. D. Sills	X			
1957	Donald L. Rose				X
"	Stanley Radzyminski				X
"	Ralph R. Beattz				X
"	P. T. Rasch				X
"	James Crakes				X
"	Robert Kruse				X
"	K. Mathews				X

(continued next page)

Year	Author	Isometric	Isotonic	Comb.	No Sign. Diff.
1957	W. P. Morgan				X
"	L. E. Morehouse		X		
1958	Peter V. Karpovich				X
"	G. L. Rarich	X			
"	G. J. Larsen	X			
"	Peter Clenlzns		X		
"	Robert P. Maylery		X		
"	Liberson				X
1959	Marxim M. Asa				X
"	Paul Eugene Meadows		X		X
"	J. Scherner				X
"	A. Bourguignon				X
"	B. Newlin		X		
1960	C. E. Walters				X
"	C. L. Stewart				X
"	E. M. Henry	X			
"	J. D. Whitley				X
"	D. H. Clark		X		
"	W. P. Pierson	X			
1961	G. T. Adamson				X
"	J. H. Kahnert	X			
"	Lois Perkins		X		
"	Thomas Hettinger	X			
1962	Hugh Thompson				X
"	Maxwell L. Howell		X		
"	Richard Berger				X
"	M. S. Lawrence	X	X		
"	H. R. Meyer	X	X		
"	Hellebrandlt		X		
"	Richard Arden				X
"	William Paul Marley		X		X
1963	Stan Burnham			X	
"	Francis Darling			X	

(continued next page)

Year	Author	Isometric	Isotonic	Comb.	No Sign. Diff.
1963	Gene Hooks		X		
"	Harrison Clarke	X			
"	John R. Richards		X		X
1964	Earl Wallis	X			
"	Donald Macintosh		X		
"	Dean Miller			X	
"	Jane Besler	X			
1965	Hal Higdon			X	
"	Jay A. Bender			X	
"	Dr. Paul			X	
"	Megeisdorf			X	
"	Gary Marriott			X	
"	James Busky			X	
"	Vince Lomabardi			X	
Total	Split Opinion 5	13	13	10	24

In observing Table I, one can see that there has been a trend toward the belief that there is no significant difference between a program of isometric and isotonic exercise. Out of the sixty-five authors, twenty-four stated or inferred there is no significant difference between a program of isometric or isotonic exercise. Thirteen out of the sixty-five authors advocated the use of isometric exercise in their writing. Many of them believed that isometric exercise produced strength sooner with less time and effort. Thirteen other authors believed the isotonic exercise was a better method of exercising in order to increase strength, flexibility and the ability to perform an activity.

Ten more believed isometric and isotonic exercise should be combined. These ten also indicated that some type of running activity is needed with this combination. Five other authors indicated that they had a split belief. For example, Paul Eugene Meadows believed that there was significant difference between isometric and isotonic exercise in an overall development, except that isotonic exercise produced more improvement while doing pull-ups.[43]

There seemed to be a slight trend throughout the last ten years, which can be noted on Table I and will be explained on the next four pages. During 1955 and 1956, there was a trend toward following the belief in isometric exercise. Isometric's appeared to be the answer in developing a better athlete or just to main-tain physical fitness with less time and effort.

In 1957, through a testing program, Mathews and Kruse came up with the opinion that there was no significant difference between the means of the Isotonic and Isometric groups, although it was observed that the isometric type exercise caused a greater number of subjects to gain significantly in strength.[44] However, in 1957 a majority of the articles written contained

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[43]Meadows, Paul Eugene. "The Effect of Isotonic and Isometric Muscle Contraction Training on Speed, Force and Strength." Thesis Ph. D. University of Illinois, 1959.

[44]Mathews, D. K. and R. Kruse. "Effects of Isometric and Isotonic Exercises on Elbow Flexion Muscle Groups." Research Quarterly, March 1957.

beliefs that there were no significant differences between isometric and isotonic exercises in developing strength. Out of the ten authors during 1957, only two indicated a belief in isotonic's as being a superior method of exercising for the development of strength. The other eight believed that there was no significant difference in any tested.

In 1958, there wasn't any difference in views expressed in the articles published by the major authors. Out of six authors, two emphasized isometric exercises, two advocated isotonic to develop strength and performance, and two suggested that there was no significant difference in the overall development. During this year, there seemed to be more emphasis placed on the different body capacity developed by the different exercises. One type of exercise will be more beneficial in developing flexibility and the other will be more beneficial in developing strength and endurance. During the year of 1959 came individual complex studies which advocated exer cises which would develop strength, but not necessarily strength during an activity.

From 1960 through 1963, ideas were very controversial. Out of twenty-one authors' opinions, eight indicated that there were no significant differences between the two types of exercises, five believed in isotonic, seven believed in isometrics, and four believed in some type of combination. In 1962 and 1963, the idea of a combination of isometric and isotonic exercise was

bably misunderstood the earlier writings. Different authors may have misquoted and also were misquoted as can be noted by some of the quotations from this paper. Never the less, by 1964-1965, many articles had been written that advocated a combination of isometric and isotonic exercise to produce the best all around effect. "The Exer-Genie is very much needed as a 'breakthrough' in that it combined the latest theories in resistive exercise. By starting each exercise isometrically we get strength benefits of this new school of exercise, and by combining it with isometric movement, we get the benefits of endurance and flexibility."[45]

Tables II, III, IV, V and VI identify the different body capacity in which the authors believed a certain type of training program will develop.

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[45] Op. Cit. Exer-Genie, 1964.

TABLE II

BODY CAPACITY DEVELOPED AS PROPOSED
BY THE ISOMETRIC SUPPORTERS

Year	Author	Strength	Performance	Endurance	Flexibility	Girth	Gen.
1955	Robertson						X
1955	Dinker						X
1955	Baer	X		X			
1955	Gerston	X					
1956	Wolbers	X					
1956	Sills	X					
1958	Rarich						X
1958	Larsen						X
1961	Kahnert	X					
1961	Hettinger						X
1963	Clarke						X
1964	Wallis						X
1964	Besler	X					

Table II (above) shows the body capacity developed as supported by the authors that believed in the isometric exercise program. One can readily note that six or forty-six per cent of the authors believed that isometric training will develop strength. Seven, or fifty-three and eight hundredths per cent felt that isometrics was responsible for the overall general body development.

TABLE III

BODY CAPACITY DEVELOPED AS PROPOSED BY

THE ISOTONIC SUPPORTERS

Year	Author	Strength	Performance	Endurance	Flexibility	Girth	Gen.
1957	Rasch	X					
1957	Morehouse						Psych. & Physio.
1958	Clentzas		X				
1959	Mayberry	X					
1959	Newlin		X				
1960	Whitly	X					
1960	Clark	X					
1961	Perkins						X
1960	Henry	X					
1962	Howell	X					
1962	Hellebrandt						X
1963	Hooks				X		

Table III reveals the body capacity developed through isotonic exercises. Fifty per cent of the authors believed that the major capacity developed was strength of certain parts of the body.

TABLE IV

BODY CAPACITY DEVELOPED AS PROPOSED BY
NO SIGNIFICANT DIFFERENCE SUPPORTERS

Year	Author	Strength	Performance	Endurance	Flexibility	Girth	Gen.
1955	Steinhaus	X					
1955	Salter	X					
1955	Lorback	X				X	
1955	Darcus	X					
1956	Rodgers						X
1957	Rose	X					
1957	Radzgminski	X					
1957	Beatty	X					
1957	Craker	X					
1958	Karpovich	X					
1957	Kruse	X					
1958	Liberson	X					
1957	Morgan	X				X	
1959	Asa			X			
1957	Mathews	X					
1959	Meadows						X
1959	Scherner		X				X
1959	Bourguiznon						X
1960	Wallers						X
1960	Stewart						X
1960	Pierson						X
1961	Adamson	X			X		
1962	Thompson	X					
1962	Berger						X
1962	Boileau	X				X	
1963	Burnham	X					

Table IV on the proceeding page indicates the authors that believed there was no significant difference in body capacity developed between isotonic and isometric exercise. The No Significant Group was concerned with mostly strength of varying parts of the body.

TABLE V

BODY CAPACITY DEVELOPED AS SUPPORTED BY THE SPLIT BELIEF SUPPORTERS

Author	Year	Strength	Performance	Endurance	Flexibility	Girth	Gen.
ISOMETRIC							
Lawrence	1962			X			
Meyer	1962			X			
NO SIGNIFICANT DIFFERENCE							
Meadows	1959						X
Marley	1962	X					
Richards	1963			X			
ISOTONIC							
Lawrence	1962	X					
Meyer	1962	X					
Marley	1962					X	
Richards	1963	X					
Meadows	1959	X					

The above Table V shows the beliefs of the Split Group as to the development of different body capacities. This Split Group contains the various authors who believed that isometric exercises develop strength as isotonic exercises develop endurance in the same individual. This group measured strength, endurance and girth.

TABLE VI

BODY CAPACITY DEVELOPED AS PROPOSED BY THE COMBINATION SUPPORTERS

Author	Year	Strength	Performance	Endurance	Flexibility	Girth	Gen.
Darling	1964	X	X		X		
Miller	"	X	X		X	X	
Higdon	1965	X					X
Jay Bender	"	X	X	X	X		
Dr. Paul	"	X	X	X	X		X
Magelsdorf	"						X
Marriott	"	X				X	
Busky	"	X	X	X	X		
Lomabordi	"	X	X	X	X		

Table VI shows the different body capacities the authors of the combined group stressed. The combination group advocated that a combination of isotonic and isometric exercises improve strength, performance, endurance, flexibility, girth and general body development. These authors made stipulations that individuals must work out conscientiously in order to achieve improvement.

TABLE VII

BELIEFS AS TO AREA CONCERNING ISOMETRIC, ISOTONIC OR A COMBINATION

Area	Author	Isometric	Isotonic	No Sign.Diff.	Comb.
Pennsylvania State Univ.	Lorback			X	
Pennsylvania State Univ.	Swegan	X		X	
Iowa Univ.	Rogers			X	
Oregon Univ.	J. Clarke			X	
Oregon Univ.	H. Clarke	X			
Oregon Univ.	Macintosh		X		
Maryland Univ.	Morgan			X	
Maryland Univ.	Boileau			X	
Maryland Univ.	Marley		X		
Springfield College	Asa		X		
Illinois Univ.	Meadows			X	
Chicago	Adamson			X	
Springfield College	Hettinger	X			
Southern Ill.	Paul			X	
California	Clentzans		X		
California	Miller				X
Michigan State Univ.	Mayberry		X		
Australia	Howell		X		
Washington D.C.	Hellebrandt		X		
Kansas State Univ.	Darling			X	
Kansas State Univ.	Marriott				X
Emporia College	Besler	X			
Alberta Univ.	Richards		X		
Wisconsin Univ.	Busky				X
Wisconsin Univ.	Lomabordi				X

Table VII shows twenty-four authors from various parts of the country and what they believe is the most beneficial type of physical training. This table indicates that there are no correlations or relationships of ideas in any certain locality and vice versa among the various authors.

AUTHOR'S RELATED RESEARCH

For futher verification of results pointed out in related literature and to help identify the best training programs, a study was conducted by the author on isometrics, isotonics and a combination of the two programs. Twenty-eight freshmen students enrolled in a basic physical education class, during the fall semester of 1965, were used for this study. The class was a weight training class made up of individuals who ranked low on the Barrows motor ability test. This motor ability test is used by the Physical Education Department at Kansas State University as the method of dividing and placing students for different classes. All basic physical education classes met twice a week. At the beginning of an eight week period, measurements of girth were taken of the calf, neck, biceps, thigh and waist of the subjects. Strength of leg-back muscles and arm curl muscles were measured by a dynamometer and the number of pulls were also counted.

The class was divided in half by alphabetical placement. The entire class work-out consisted of calisthenics and a weight training program. The weight training program was made up of six lifts done in a double progressive manner. These six lifts were: (1) military press, (2) curl, (3) rolls, (4) toe raise, (5) squats and (6) pull-overs. One half of the class also used a form of isometrics which the Kansas State Varsity football team used as a supplement to their work-outs.

These isometric exercises were designed so that they could be done by using a door-way to push against. These different isometric exercises correlated with the different weight lifts in the study.

Tables will follow showing the individual comparisons as well as the over-all comparisons, and a discussion of each table will follow the charts.

TABLE VII

INDIVIDUAL IMPROVEMENT OF GIRTH

OF THE ISOMETRIC AND ISOTONIC GROUP

Isometric & Isotonic	Biceps	Upper Leg	Calf	Chest	Neck	Waist
1	1	1/2	1	1	-	2
2	1 1/2	1	-1/2	1/2	1/2	-
3	2	-	-	-	-	2
4	1 1/2	-	-	1 1/2	-	2
5	1	-	-	1 1/2	1/2	1 1/2
6	1/2	-1/2	-	-	-1/2	-1/2
7	1	1	-	1 1/2	1/2	1 1/2
8	-	1/2	-	-	1/2	3
9	-	-	-	-1	-1/2	2
10	-1	1	-	1/2	1/2	1 1/2
11	-	-	-	-	-	-
12	1	-	-	1	1/2	2
13	1 1/2	1/2	1/2	1/2	1/2	3
14	-	-	-	-	1/2	2
Total increase	10	4	1	6	3 1/2	22
Mean increase	.71	.28	.07	.42	.25	1.6

Table VIII shows the individual gain of the combined isometric and isotonic exercise in the girth of the biceps, upper leg, calf, chest, neck and waist. The mean increase of the girth of the biceps was seventy-one hundredths inches, and the mean increase of the waist was one and six hundredths inches. These were the only two parts that were measured which showed significant increase, although other parts did show a small increase. The calf had the least improvement, with it's mean increase of seven hundredths inches.

TABLE IX

INDIVIDUAL IMPROVEMENT OF GIRTH

OF THE ISOTONIC GROUP

Isotonic	Biceps	Upper Leg	Calf	Chest	Neck	Waist
1	1 1/2	1 1/2	-	1	1	2 1/2
2	1	1	-	1	-	1
3	1	1/2	-	1 1/2	-	2
4	1 1/2	1 1/2	-1/2	1 1/2	1	3
5	-1/2	-1/2	-1/2	-1	-1	-2
6	1	-	-	1	-	1
7	1/2	-	-	-	-	-
8	-1/2	-1/2	-	-1/2	-1/2	-
9	1	1	1/2	1	-	2
10	1	1	-	1	1	2
11	1/2	1/2	-1/2	1/2	-	1 1/2
12	-1/2	-1/2	-	-	-	1 1/2
13	-	-	-	-	-	1 1/2
14	1/2	1/2	1	1	1/2	2
Total increase	8	6	0	8	2	18
Mean increase	.56	.44	0	.56	.14	1.4

Table IX shows the individual improvement of the Isotonic group in the girth of the biceps, upper leg, calf, chest, neck and waist. There was a mean increase in girth of all parts measured, except the calf, which had a mean increase of zero. The total group increase of the biceps was eight tenths inches and the mean increase was fifty-six hundredths inches. The upper leg group had a total increase of six inches and a mean increase of forty-four hundredths inches. The mean increase of the chest was fifty-six hundredths inches and the total group increase was eight inches. The neck did not increase significantly enough to mention. The waist again had the largest gain with a total group increase of eight inches and a mean increase of one and four hundredths inches.

TABLE X

MEAN DIFFERENCE OF GIRTH OF COMBINED GROUP AND ISOTONIC GROUP

Groups	Biceps	Upper Leg	Calf	Chest	Neck	Waist
Isometric & Isotonic Mean Increase	.71	.28	.07	.42	.25	1.6
Isotonic Mean Increase	.56	.44	0	.56	.14	1.4
Mean Differences	.15	.16	.07	.14	.11	.2

The above Table X shows the mean difference between the combined group and the isotonic group girth. There is no significant difference between the two groups as to the mean difference.

The mean difference of the girth of the biceps was fifteen hundredths inches with the combined group having more improvement. The upper leg mean difference was sixteen hundredths inches with the isotonic group showing more improvement. The calf had a mean difference of seven hundredths inches with the combined group showing very little improvement. The neck was of a mean difference in girth of eleven hundredths inches in improvement of the neck as shown by the combined group of exercises. The mean difference of the girth of the chest was fourteen hundredths inches with the isotonic group showing more improvement. The mean difference of the girth of the waist was

two hundredth inches mean difference with the combined group having more improvement.

TABLE XI

INDIVIDUAL IMPROVEMENT OF STRENGTH

OF THE ISOMETRIC AND ISOTONIC GROUP

Isometric & Isotonic	Leg & Back	Arm Curl	Pull Ups
1	180-185	70-73	9-11
2	110-165	75-90	6-10
3	210-170	60-80	6-10
4	110-125	95-95	3-5
5	150-160	120-125	5-8
6	160-160	130-130	5-6
7	80-90	95-95	10-10
8	120-150	90-110	0-0
9	130-150	80-90	1-2
10	110-140	70-100	7-9
11	130-140	100-110	2-2
12	130-150	90-110	9-11
13	110-150	90-110	5-10
14	110-130	90-110	6-10
Total	1840-2165	1155-1418	74-103
Total increase	225	263	24
Mean increase	16.07	18.6	2.1

The preceeding Table XI shows the measure of the improvement in the individual strength of the combined isometric, isotonic group, the strength of the leg and back muscle group, arm curl (arm flexion) muscle group. Also, the number of pull-ups were counted at the beginning and at the end of the eight week period.

There was a total increase of 225 pounds by the group in the leg/back strength and a mean increase of sixteen and seven hundredths pounds. The total individual increase of the arm curl muscle group was 263 pounds. The mean increase of this exercise was eighteen and six hundredths pounds. Just two out of fourteen subjects didn't increase in strength by the arm curl. Only three out of fourteen didn't increase in the number of pull-ups, although there was a mean increase of two and one hundredths in pull-ups.

TABLE XII

INDIVIDUAL IMPROVEMENT OF STRENGTH

OF THE ISOTONIC GROUP

Isotonic	Leg & Back	Arm Curl	Pull Ups
1	160-180	80-110	4-5
2	150-180	70-90	14-14
3	120-160	60-110	9-10
4	105-120	50-60	4-4
5	150-195	100-115	0-0
6	160-175	80-100	3-4
7	130-160	70-100	7-10
8	125-125	80-100	6-9
9	140-150	80-110	4-7
10	130-130	90-110	2-5
11	150-150	90-95	0-2
12	130-165	110-125	5-8
13	125-140	70-110	5-10
14	125-140	60-80	3-5
Total	1900-2150	1110-1415	74-103
Total increase	250	305	24
Mean increase	17.8	21.8	2.1

The preceeding Table XII gives the individual scores and improvement in strength of the isotonic group. The total increase in strength of the leg/back muscle group was 250 pounds and had a mean increase of seventeen and eight hundredths pounds. The arm curl muscle group had an increase of 305 pounds in strength, with a twenty-one and eight hundredths pounds mean increase. The total increase in pull-ups was twenty-four pounds and a mean increase of two and one tenth pounds. There were only three out of fourteen that didn't increase in the number of pull-ups.

TABLE XIII

MEAN DIFFERENCE OF THE STRENGTH FOR COMBINED GROUP AND ISOTONIC GROUP

Groups	Leg and Back	Arm Curl	Pull Ups
Combined Mean Increase	23.2	18.6	2.1
Isotonic Mean Increase	17.8	21.8	2.1
Mean Differences	5.4	3.2	-

Table XIII shows the mean difference between the strength of the combined isometric and isotonic group and the isotonic group.

The combined group had a five and four tenths pounds greater mean increase in strength of the leg/back muscle group than the isometric group. There was a three and two tenths pounds mean difference in the strength of the arm curl with the isotonic group having the greater improvement. There was no difference in the number of pull-ups between the two groups.

Results obtained by the author study are as follows:

1. The combined isometric, isotonic group developed more in strength in the leg/back muscle group than the other group.

2. The isotonic group developed arm curls more significantly than the combined group.

3. Both groups had the same high improvement in the pull ups.

4. There was no significant difference in the girth of the biceps, upper and lower leg, and the neck and waist.

5. This study indicated that there was no real significant difference between the two groups, but the combined group seemed to be beneficial to the individual who believed in this type of exercise.

SUMMARY AND CONCLUSION

SUMMARY

The present study was designed to (1) identify the most beneficial type of exercise for physical training and to (2) show the trend of the last ten years of beliefs concerning isometric, isotonic or a combination of the two. Two minor values of this study were to show whether or not there was regional development of ideas and to show what type of exercise developed in a certain phase of physical education and what phase has been given more attention.

Sixty-five opinions were gathered to achieve the above objectives. These authors which supplied the material were gathered from major universities over the nation, major professional magazines, and the facilities at Kansas State University. The author also made a study concerning this subject to help familiarize himself with the problems of such studies and to have firsthand material on which to base the conclusion.

CONCLUSION

From this study it was found that over the last ten years, many writers have advocated that there is no significant difference between isometric and isotonic exercises. Because of the recent agreement of such a large percentage of the writers reviewed and the difference of opinions, the author believes that a combination of isometric, isotonic program is the most beneficial type of exercise for total physical training.

According to this study, isometric and isotonic exercises had equal amounts of positive support through the last ten years. Of course, there have been split views among individual authors.

The works of the writers examined showed a definite trend of belief as to the most beneficial type of exercise for a program of physical training. Beginning with 1955-1957, isometrics were emphasized, then the idea of no significant difference came in at the end of 1957. Later, in 1959-1963, there began a transition period in which there were many mixed beliefs. In 1964-1965, more authors began to support the belief for a combination program.

There was not, however, a regional difference in development of ideas concerning isometric, isotonic exercise.

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APPENDIX I

"Silvey" List of Thesis over the Ten Years Concerning Isometric and Isotonic Exercises

1964-1965

Brown, Wallace M. "The Effects of an Eight Week Weight Training Program upon Reaction Time and Movement Time." 384

Bucy, Jesse C. "A Comparison of the Effect of Three Methods of Training on Physical Fitness."

Clark, David F. "The Effect of Prescribed Isometric Exercise on Strength, Speed and Endurance in Swimming the Crawl Stroke."

Drury, Thomas R. "A Comparative Study of the Effects of Isotonic and Isometric Exercise on the Vertical Jumping Ability of Seventh and Eighth Grade Boys." 195

Fassdender, William. "Daily vs Alternate Days on Isometric Exercise for the Development of Arm and Shoulder Strength in Seventh and Eighth Grade Boys." 356

Hannett, John. "The Effects of an Isometric Training Program and a Weight Training Program on the Vertical Jump, Dynamic Strength, Static Strength and Thigh Girth in Male College Students." 185

Harris, Robert. "The Effects of Isometric Exercises on the Physical Fitness Test Scores of Freshmen Men at Moorhead State College." 196

Kranz, Alfred C. "A Comparative Investigation of the Effectiveness of Three Isometric Contractions and One Isometric Contraction for Certain Selected Muscle Groups."

Lindbloom, Valerie J. "Comparing the Effectiveness of Isometric and Isotonic Exercises as a Measure of Strength on the Wrist Flexons of the Dominate Arm." 116

Mitchell, Thomas A. "A Comparative Study of the Effectiveness of Isometric and Self-Testing Exercises in Developing Muscular Strength." 292

Nelson, James P. "An Experimental Investigation of a Program of Isometric Exercise for Developing Upper Body Muscular Strength."

Poston, Billiel. "A Comparison of Isotonic and Isometric Exercises for the Development of Muscular Strength and Endurance in College Women. 384

Rummel, Rose M. "A Comparative Study of the Contributions Made to Physical Fitness by the Addition of Planned Isometric and Isotonic Exercise at the Beginning of Each Class Period of a Regular Program." 377

Scolnick, Tony. "A Comparison of the Effects of Selected Exercises, Isometrics and Isotonics on Explosive Power and Leg Strength." 175

Scott, Arnold D. "Comparison of Isometric and Isotonic Exercises as Methods of Building Strength."

Smith, William. "The Effect of Isometric and Isometric Muscle Training on the Strength and Endurance of Junior Secondary School Boys." 460

Baker, Boyd B. "An Investigation of Physical Fitness Achievement Through Weight Training as Compared to Body Conditioning." 438

1963-1964

Estep, Jay D. "A Comparison of the Effects of Isometrics and Isotonic Training for Strength Development." 380

Kelly, Willis R. "The Comparison of Two Training Program, Isometric Contractions and Calisthenics on Strength and Selected Body Measurements of Female College Freshmen." 377

McCormick, James J. "A Study to Determine the Effects of Isometric Exercise on Speed of Leg Movement Involved in Place Kicking." 175

Shefcyke, Dennis L. "The Effect of Isometric Contraction and Calisthenic Exercises on Strength Development of Male College Freshmen." 377

Ward, Paul E. "The Effects of Isometric and Isotonic Exercises on Strength, Endurance and Anthropometric Measurements." 439

1962-1963

Avant, Bobby J. "Effect of Isometric Strength Development on Angles of Knee Extension Above and Below the Point of Application." 55

1960-1961

1958-1959

1956-1957

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A NATIONAL STUDY ON THE LAST DECADE OF RESEARCH ON ISOMETRIC AND ISOTONIC RELATIONSHIP

by

MICHAEL D. PENROD

B. S., in Phy. Ed., Kansas State University, 1965

AN ABSTRACT OF A MASTER'S REPORT

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requirements for the degree

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The first purpose of this study is to summarize certain of the nations author's writings that have appeared in the last ten years concerning the most beneficial type of training programs. The second purpose is to point out the trends during the last ten years as stated by selected authors in the field. These will be in the form of a short review of research and beliefs as expressed in various writings concerning the best method as related to isometric and isotonic exercise and a combination of the two exercises. The third purpose is to point out different author's beliefs as to what body capacity is developed, namely flexibility, endurance, girth, strength and general body development, through the isotonic, isometric or combined training program. The fourth purpose was to point out the training program of twenty-four selected authors beliefs from the different areas of the country, to discover if there is a common belief on the best method of training for physical development.

In order to obtain a true picture, sixty-five opinions have been sorted out of what has been written during the past ten years. Many universities have been written to get information concerning isometric, isotonic comparisons. Visits were made to the Washington University Library and to the St. Louis University Library to obtain information. Also, the author made an eight week study at Kansas State University to inform and familiarize himself with the subject, and to have better ideas on which to base his conclusion.

The results that follow give the conclusions.

1. Twenty-six out of sixty-five authors advocated there is no significant difference between isometric and isotonic exercise in the development of strength.

2. Because of the more recent studies of the last three years, and the large per cent of agreement, the combination of the two exercises seems to be the best type of physical training program.

3. The trend during this ten year period has been from isometric, a no significant difference between the two, a transitional period, and now a combination is being suggested as the most beneficial type of training.

4. There has been no indication that there is a certain regional belief concerning the most beneficial type of physical training program. The differing opinions are the same all over the nation.